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Abstract

This research project is part of the sorghum breeding program at ISU, which has the ultimate goal of evaluating the potential of ISU inbred lines as parents of lignocellulosic hybrids. The objectives of this research project were:

- To determine the biomass yield of experimental hybrids, and its performance relative to commercial materials
- To determine the effect of lodging and planting density on final biomass yield
- To determine the level of association between plant height and lodging

Keywords

RFR A1292, Agronomy

Disciplines

Agricultural Science | Agriculture | Agronomy and Crop Sciences

Performance of Experimental Biomass Sorghum Hybrids from the ISU Breeding Program

RFR-A1292

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Introduction

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- To determine the level of association between plant height and lodging

Materials and Methods

A total of 129 hybrids were planted in three locations (Greenfield, Crawfordsville, and Ames) in a completely randomized block design. Each material was planted at a density of 140,000 plants/ha, or 56,000 plants/acre, in a two-row plot with two replications/location. Row spacing was 30 in. and plot length was 15 ft. Planting dates were May 18 (Ames), May 22 (Crawfordsville), and May 23 (Greenfield).

Hybrids included:

- Grain type: 8 experimental hybrids
- Dual purpose: 1 commercial and 15 experimental hybrids
- Forage type: 12 commercial and 55 experimental hybrids
- Photoperiod sensitive: 4 commercial and 34 experimental hybrids

Total biomass, expressed as tons of dry matter per hectare (Tn/ha, dm), was obtained by harvesting whole plots before the first killing frost using an experimental forage chopper adapted with a Harvest Master system. A sample of each plot was collected and dried to constant weight to estimate moisture content. Plant height and final plant density were recorded in the three locations and lodging was visually determined using a 1-5 scale (1, no lodging to 5, completely lodged) in two locations (Ames and Greenfield).

Results and Discussion

There was a significant variation in all traits analyzed (yield, height, and lodging) (Table 1) with a maximum single plot yield of 43.88 Tn/ha dry matter. Crawfordsville was the highest yielding location, followed by Ames (Figure 1). Greenfield was the lowest yielding location, in spite of having better general standability than Ames.

Grain sorghums were, in general, the shortest group (mean=139.3 cm or 54.8 in.), followed by dual purpose sorghums (mean=186.9 cm), forage sorghums (mean=264.2 cm), and photoperiod sensitive sorghums as the tallest group (mean=275.8 cm). Even though plant height and lodging were significantly and positively correlated (Table 2), lodging was more severe in forage (mean=2.38) and dual purpose types (mean=1.35) than in photoperiod sensitive hybrids (mean=1.08). These results confirm, as in previous years, that height is not the main cause of lodging but the combination of tall plants with grain on top significantly increases the susceptibility to lodging.

Plant height was the most highly correlated trait with biomass yield, but final stand

density also was positively correlated with yield. As expected, lodging was negatively correlated with yield (Table 2). Some experimental hybrids had higher or similar biomass yields as the best commercial hybrids (Figure 2).

This project confirmed previous results on the effect of different traits on final biomass yield and provided additional evidence of the performance of inbred lines in hybrid combinations for further selections in the ISU sorghum breeding program (Figure 2). Biomass yields in 2012 were, in general,

superior to yields in 2010 in spite of the severe drought experienced in Iowa, demonstrating the value of sorghum as a drought tolerant crop.

Acknowledgements

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Table 1. Summary of hybrid performance over the three locations.

	Mean	Range	Std Dev
Yield (Tn/ha dry weight)	19.70	4.76- 43.88	7.00
Height (cm)	250.54	105.41-420.37	56.57
Lodging (1-5)	1.78	1-5.00	1.27

Table 2. Correlation coefficients between all traits.

	Yield	Lodging	Height
Yield	-		
Lodging	-0.275*	-	
Height	0.677*	0.142*	-
Final density	0.187	0.099	0.103*

*Indicates significance at the $P > 0.01$ level.

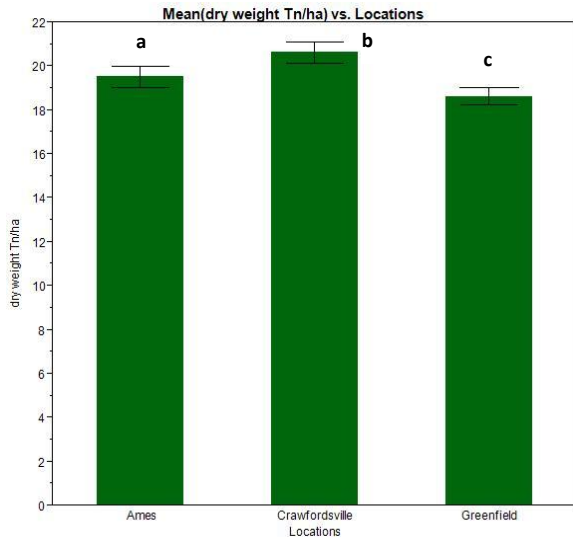


Figure 1. Average biomass yield per location. Each error bar represents one standard error from the mean. Locations not labeled with the same letter are significantly different at $P \leq 0.05$ (Tukey-Kramer test).

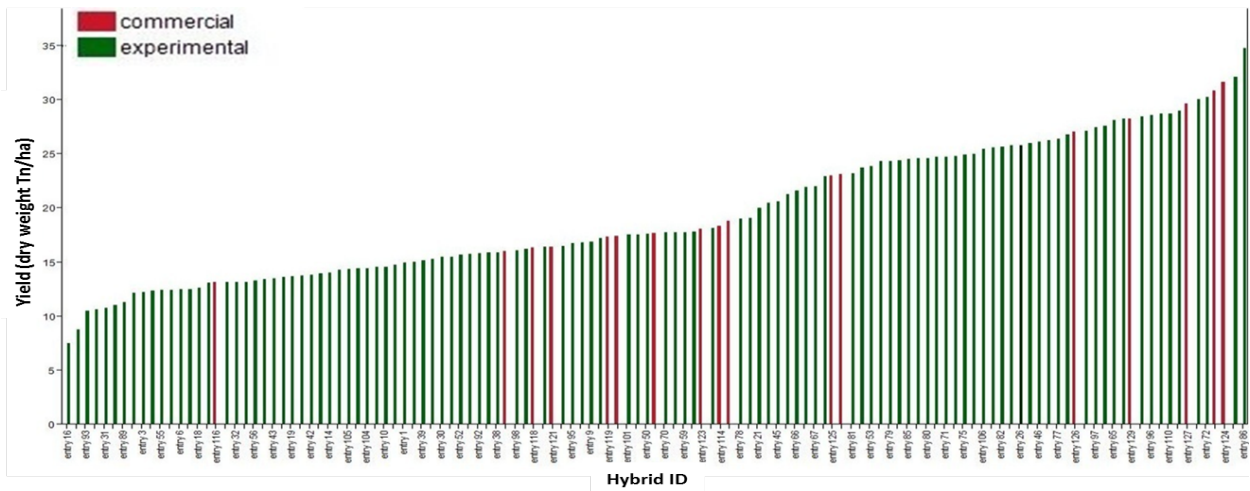


Figure 2. Biomass yield of experimental and commercial sorghum hybrids. Yields are averaged over replications and locations.